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Energy barriers for cellular rearrangements in tissues[1] DAPENG BI, J.H. LOPEZ, J.M. SCHWARZ, M. LISA MANNING, Syracuse University —

The behavior of cellular aggregates strongly influences morphogenesis, cancer growth and wound healing. While single cell mechanics has been extensively studied, the collective dynamics of cells inside a tissue is not well understood. Recent experiments have shown cells in tissues behave like fluids on long timescales and solids on shorter timescales, and exhibit caging behavior at intermediate timescales as they are more tightly packed. These observations are reminiscent of dynamic slowing down and dynamical heterogeneities due to mutual confinement and crowding of particles glassy systems. A common and crucial feature of glassy systems is the existence of a Potential Energy Landscape (PEL) for local rearrangements. For thermal glassy materials, when these barriers are large compared to thermal fluctuations, its rheology is dependent on the PEL and external mechanical driving. In contrast, cells in a tissue are non-thermal and overcome energy barriers in the PEL mainly through local active processes, i.e. making new adhesions and cell shape changes. We numerically map the PEL of a confluent tissue as functions of different transition pathways and single cell properties. Analytical calculations are also performed to find the minimal energy shapes for 2-D confluent cell packings.

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